Kepler Mission PowerPoint Suggested Script

Use with KeplerMission.ppt

PRESENTATION NOTE:

This presentation can take 30 to 45 minutes.

1	A key goal of NASA is the search for life in the universe. NASA has a mission which is NASA's first mission dedicated to detecting Earth-size planets <CLICK> orbiting in the habitable zone <CLICK> of Sun-like stars. <CLICK> It launched in March of 2009
2	Right now, scientists can only guess at how many Earth-size planets there are out there. <CLICK> By 2013, we'll have a much better idea with the findings from NASA's Kepler Mission. That's only [number of years] years away. [if there are children or teenagers in the group] Who will be in high school or college by then?
3	By far, planets that are found most often are those close to the mass of Jupiter or larger. Most, if not all, of these are probably gaseous giant planets. Our quest is to find the tiny Earth-sized planets.
4	Almost all the planets discovered so far have used the radial velocity or "star wobble" method. < 5 CLICKS > *(Read information on slide)* This has not proved to be sensitive enough to detect small Earth-sized planets.
5	Kepler mission will find small planets passing between us and their parent star by detecting transits. A transit occurs when a planet crosses the line of sight between an observer and a star and blocks a small amount of light from the star, causing the light from the star to dim slightly for a few hours. A large planet, like Jupiter will cause a much larger drop in light than an Earth-size planet.
6	But stars are very far away. Many light years away. So let's move this star away. (Moving star away for the next few slides)
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13	Can you see the planet moving across this star?
14	What Kepler is doing is watching for the slight dip in the light from a star

	caused by a planet passing between us and its parent star. For an Earth sized planetary transit – it's about the light dimming that a ladybug would cause walking across a searchlight.
15	Here is an example of a star that Kepler might be watching. (1500 days is a little over four years). This star looks like it might have two transiting planets. Can you see them both? This shows that we started watching the star here. (Indicate the zero on the x-axis) On the left(indicate the y-axis), this shows how much light from the star is being detected. At 100%, no planets are transiting. After about 325 days, we detect a drop in the light of about 1.4% from the star. Then about 700 days later, another drop in light of the same amount! Is this is big planet? <CLICK> Here's a potential planet about the size of Jupiter crossing between us and the star. This might be a planet orbiting the star about every 700 days. But where's the other planet? <CLICK> Can you see the drop in light now? What size planet is that one? <CLICK> That looks like an Earth-size planet! It is causing a drop in light of 1/100th of a percent! How many days does it take to orbit? - Right, a little over 250 days. How many more times did Kepler detect the same drop in light from this star during the four-year period? Yes, 3 more times!
16	But only some planetary systems will be at the right angle from our point of view. What one is it? <CLICK> *(Read answer on slide)*
17	Here's the Summer Triangle. <CLICK> Kepler will be monitoring 100,000 stars in an area of the sky the size of you fist held at arm's length. <CLICK> That area is between two of the stars in the Summer Triangle, just above the plane of the Milky Way.
18	The probability for the orbits to be properly aligned is about one-half of one percent when the planet is in an orbit around its star similar to the earth's orbit around our Sun. So, for example, if ALL the 100,000 stars had Earth-size planets orbiting in the habitable zone, Kepler would probably detect 500 of those planets. (*See information on slide)*
19	Kepler uses transits to detect <CLICK> Earth-size planets <CLICK> orbiting in the habitable zone

	<CLICK> of sun-like stars. Let's see what each of these points means.
20	In NASA's quest to search for life elsewhere in the universe, why would <u>"Earth-size" planets</u> be best to find? If a planet is too small, it cannot hang onto a life-sustaining atmosphere. <CLICK> Too big and you've got a gas giant.
21	What is being defined as the "habitable zone"? The "habitable zone" is where evidence of life might be detected across the vastness of space. What's the most common substance in most living things? Water! And not just any water, but liquid water -- not ice and not steam. So at what distance from the star might liquid water exist? <CLICK> Here is where it is in our Solar System. Here's another system. <CLICK> Which planet is in the habitable zone in this system?
22	Let's use an analogy of a fire to represent the habitable zone. Here are three different sized fires: a candle, a campfire, and a bonfire. These represent different masses of stars. The habitable zone is where you can stand so you are not too hot or too cold. <CLICK> But this changes with the mass of the star.
23	A small cool red star has a very small and close-in habitable zone. These stars live for billions to trillions of years.
24	For a star like our Sun, the habitable zone is a little farther away. These stars live for a few billion years – enough time for a diversity of life to form.
25	A hot, bluish star only lives a few million years – not enough time for much life to form on its planets. <CLICK> A major problem with massive stars beyond short lifetimes, is that they put out most of their energy in ultraviolet -- very destructive of organic molecules on the surface of planets--makes it hard to evolve complex molecules let alone life.
26	This graphic shows the three different types of stars and their habitable zones in green. The red area is too hot for liquid water and the blue area is too cold.
27	Another thing that determines the habitablity of a planet – its temperature and whether it has liquid water – is its atmosphere. If it was a very cold night and all you were wearing was a t-shirt, would that change where you would be comfortable around the fire? How about if you were wearing a parka? What you are wearing is like the atmosphere around a planet.
28	Here's our Sun, represented by the campfire. <CLICK> This person is like Mercury. Virtually no atmosphere and very close to the Sun. Like being in the desert in a swimsuit. Daytime temperature of Mercury is 660 F (250 C) and night side is about –300 F (–180 C). Could liquid water

	exist on its surface? What is the next planet out from the Sun? <CLICK> This person, wearing a heavy jacket, is like Venus – too heavy an atmosphere too close to the Sun. Temperature of Venus is always about 880 degrees F (470 C). How hot is your oven? <CLICK> Earth's temperature varies, but does liquid water always exist somewhere on its surface? The Moon is essentially the same distance form the Sun as Earth – but has no life and no liquid water - what's different? Right, no atmosphere – daytime temperature on Moon: 273 F (134 C) Nighttime temperature on Moon: -274 F (-170 C) <CLICK> This person is like Mars: Very little atmosphere – like wearing a t-shirt in the Arctic. The temperature at the planet's surface varies widely during the course of a Martian day, from about -125 F (-87 °C) just before dawn to about -4 F (-20 °C) in the afternoon. Can it have liquid water?
29	Kepler is looking at just a small sample of our whole Galaxy. <CLICK> Stars in the same general area as our Sun. Let's zoom in a little.
30	Zooming in more
31	Kepler is observing about this much of our Galaxy, <CLICK>
32	<CLICK> Imagine, if you shrunk our solar system to a little larger than a quarter. Then, our Solar System would be this big. <CLICK> Our Milky Way Galaxy would span North America <CLICK> Kepler is monitoring stars in an area about the size of Connecticut <CLICK> (within about 3000 light years).
33	After Kepler has detected some potential transits, <CLICK> follow up work will be done to confirm it's a transiting planet and to look for evidence of life.
34	When we say "follow-up work to make sure it's a planet", what else can cause a star to dim? <CLICK>variable stars <CLICK> two stars orbiting each other. Other instruments and telescopes will verify (or not) the transit candidates Kepler finds. --------------- Credit: Eclipsing binary illustration from Goddard Space Flight Center: Imagine the Universe: http://imagine.gsfc.nasa.gov/docs/teachers/lessons/star_size/star_orbital.html

35	And how will we know a planet might support life? Even if we do find that small planet in the habitable zone, <CLICK> it has to have the right things in its atmosphere and on its surface <CLICK> to create and support life. We want to look for evidence of oxygen, for liquid water, to see if it has an atmosphere, and <CLICK> to look for signs of biological activity. ----------------------- **EXTRAS:** The recent discoveries of so-called extremophile forms of life that survive or even flourish in environments from polar ice cores to boiling, sulfurous pools to deep, dark ocean trenches has stretched our understanding of the conditions under which life can exist and, perhaps, even evolve. But, as far as we know right now, we would not be able to detect this kind of life across the vastness of space.
36	So there's an overview of <CLICK> Kepler's mission to use transits <CLICK> to detect Earth-size planets <CLICK> orbiting in the habitable zone <CLICK> of sun-like stars. Here is the Kepler website to find out more about this mission. *Optional:* So are you ready to go outside and look at the area of the sky Kepler will be watching? What else will you find in the Summer Triangle when you look through the telescopes? Let's go!